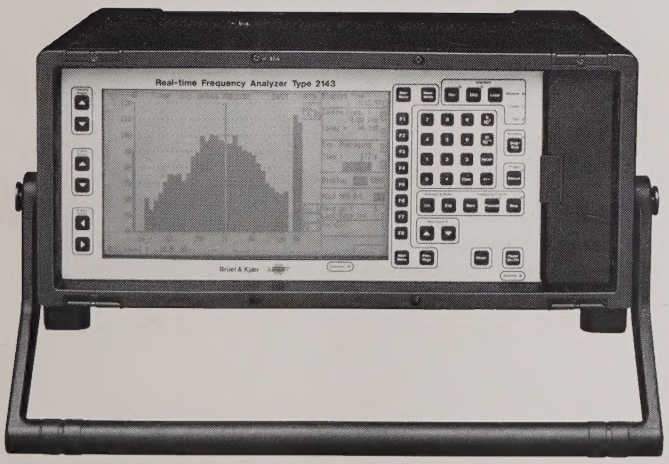
User's Guide

Real-time Frequency Analyzer
Type 2143

Vol. 2: Interface



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User's Guide
IEEE 488/RS–232–C Interface
for
Real-time Frequency Analyzer
Type 2143

From serial no. 1516960

March, 1990

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1. INTRODUCTION

1.1. PURPOSE OF THIS MANUAL

This manual describes the programming and operation of the serial and parallel interfaces of the 2143 Analyzer. It is intended as a short form reference guide for experienced IEEE 488/RS–232–C programmers and users. It is assumed that users are familiar with manual operation of the analyzer, as described in Vol. 1 of the User's Guide (Brüel & Kjær publication BB 0751-11).

1.2. SUMMARY OF CONTENTS

The following chapters give a brief description of the operation of the 2143 IEEE 488/RS–232–C interface. Only the most important specifications are described.

Chapter 2 deals with general operation and programming, while Chapter 3 examines some of the features of the RS–232–C Interface. Chapters 4, 5, 6 and 7 describe how the individual messages are used in the control of data flow between the 2143 and an interface controller. The error messages which can occur during data transfer are listed in the Appendix in Chapter 8. Chapter 9 is the index.

2. GENERAL OPERATION AND PROGRAMMING

2.1. INTERFACE CABLES AND CONNECTORS

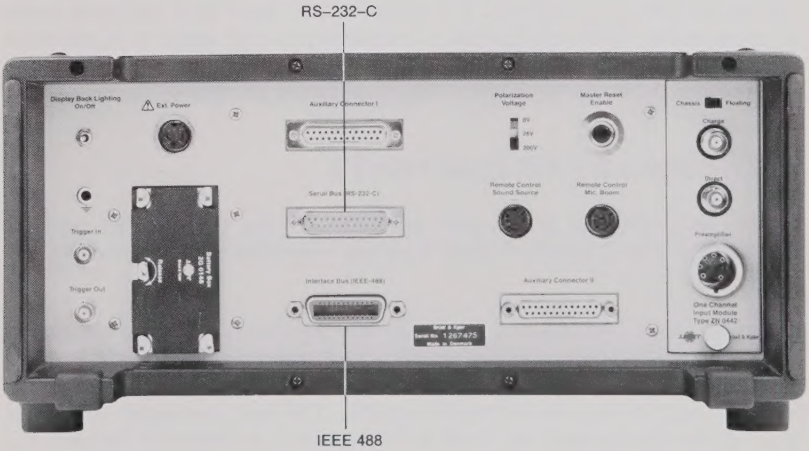

Fig. 2.1. Back panel of the 2143, showing interface connections

WARNING! Switch off all equipment before connecting or disconnecting the digital interface. Failure to do so could damage the equipment.

The following interface cables and adaptors are available from Brüel & Kjær for use with instruments with IEEE/IEC interfaces:

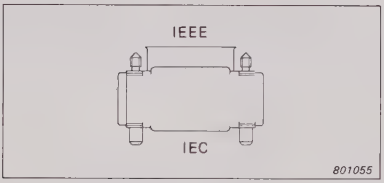

Fig. 2.2. ***AO 0195*** *Adaptor to convert IEEE-488 connector to IEC 625-1 (25-way)*

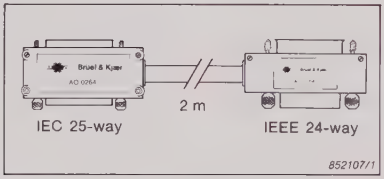

Fig. 2.3. ***AO 0264*** *Interface cable (2m), IEC 625-1 (25-way) to IEEE-488*

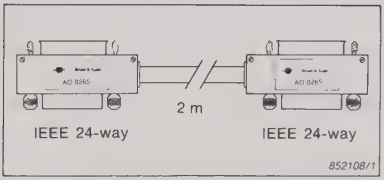

Fig. 2.4. ***AO 0265*** *Interface cable (2m), IEEE-488*

For a brief discussion of the RS–232–C connection arrangements, see section 3.1.

2.2. ACTIVATING THE INTERFACE

To activate the analyzer interface, after first switching the analyzer on, display Page 1 of the I/O interface Menu (see Fig. 2.5), then:

1. Select Interface INACTIVE, using soft key **"F2"**.
2. Select Interface Type required (IEEE 488 or RS-232-C), using soft key **"F1"**.
3. Select Interface ACTIVE.

Note: The I/O interface parameters cannot be changed with the interface ACTIVE.

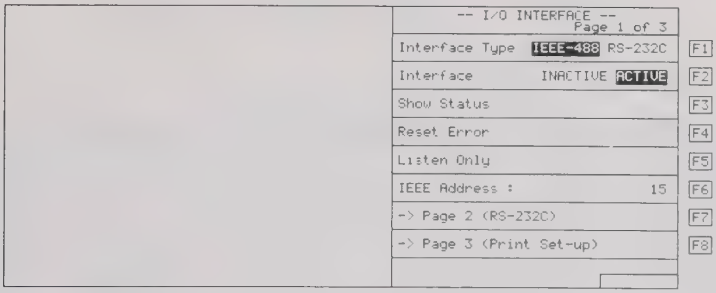

Fig. 2.5. I/O INTERFACE Menu, Page 1

2.2.1. Device Address

The 2143 IEEE Interface device address can be set using soft key **"F6"**, on Page 1 of the `I/O interface` Menu and the numeric entry keys. The possible address settings are listed in Table 2.1. The factory default setting is indicated by the shaded area.

ASCII Address Characters		Address Code
Listen	Talk	
SP	@	0
!	A	1
"	B	2
#	C	3
$	D	4
%	E	5
&	F	6
'	G	7
(	H	8
)	I	9
*	J	10
+	K	11
,	L	12
-	M	13
.	N	14
/	O	15
0	P	16
1	Q	17
2	R	18
3	S	19
4	T	20
5	U	21
6	V	22
7	W	23
8	X	24
9	Y	25
:	Z	26
;	[	27
<	\	28
=	]	29
>	^	30

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Table 2.1. Address codes for various device address settings

2.3. INTERFACE MESSAGES

Before any data can be transferred between the 2143 and an IEC/IEEE or RS-232-C controller, the data type must be specified according to the rules of syntax described in the following sections. This is called a MESSAGE. The individual interface messages are described in Chapters 4, 5, 6 and 7.

2.3.1. Message Structure

All messages sent to the analyzer start with a "header". A header consists of one or more "words". The simplest messages are made up of a single-word header.

e.g. **AV**eraging**?**

If a header requires more than one word, the words are joined by "word concatenators". Usually the underline character (_) is used as the word concatenator, but a hyphen (-) or a full stop (.) are also accepted.

e.g. **F**ILTER_**B**ANDWIDTH
TYPE_**O**F_**I**NPUT**?**

Headers ending in question marks indicate that the message will cause the analyzer to output data (output messages). Headers without question marks are used to input data to the analyzer (input messages).

Headers may be followed by one or more data fields. The header is separated from the data fields by a "header separator". The header separator for the 2143 is a space (SP).

e.g. **AW**AIT **T**RIGGER_**A**CCEPTED
SERVICE_**R**EQUEST_**E**NABLE **AL**L

If the message contains more than one data field, then the data fields are separated by a "data separator" which is a comma (,).

e.g. **T**RIGGER **T**RIGGER_**M**ODE,**AC**TIVE,**SL**OPE,**N**EGATIVE

The message must end with a valid terminator. Unless otherwise specified, the terminator is the line feed character <LF>. See section 6.2 for further details.

2.3.2. Use of Mnemonic Codes

The mnemonic is the minimum code for a message sent to or from the analyzer. The general rule is that the minimum codes are made as short as possible, consistent with their being unique. If only one word is transmitted, then the first letter (or in some cases two letters) of the word are interpreted as the mnemonic (e.g. **H**old, **T**rigger, **AW**ait, **AV**eraging). If more than one word is transmitted, the mnemonic usually becomes the first letter of each word (exceptionally the first two). These are linked by word concatenators (e.g. **A**veraging_**S**tatus, **R**eset_**S**tatus_**B**yte). Both upper and lower case letters are permitted.

The mnemonic for the header **R**eal_**T**ime_**C**lock is **R_T_C**. However, the header can be sent to the 2143 in several different formats. All the examples below will be accepted by the analyzer as valid headers:

R_T_C
r_t_c
RE_T**I**_C**L**
ReA_t_**c**LOck
REAL_**T**IME_**C**LOCK

2.3.3. Syntax for the interface message

In the following chapters syntax diagrams are used to explain the individual messages. The syntax diagrams use three types of symbols. Refer to Fig. 2.6 below:

- **Rectangular symbols** - these indicate that the enclosed data must be replaced by a data item defined elsewhere or chosen by the user. The name of the data item is quoted in the upper left-hand corner of the symbol. The data type and its permitted length, in parentheses, is given in the lower right hand corner.

- **Circular symbols** - these enclose single character literal data that must be included in the message.

- **Round-ended symbols** - elongated, round-ended symbols are used to indicate literal data. They are mainly used to illustrate message headers.

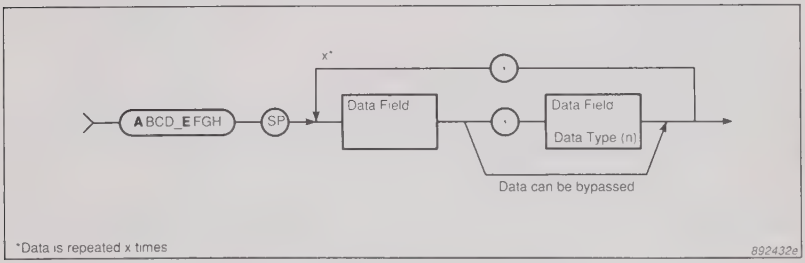

Fig. 2.6. General syntax diagram

Data items that may be by-passed are indicated by angled lines to and from the main flow line. Data items that may be repeated are indicated by a right-angled loop backwards over the data item, and back to the main flow line. If an item of data is repeated, then the number of repetitions may be indicated by a number above the flow line.

2.3.4. Data Types

The data types (and their abbreviations) used in the 2143 interface messages are as follows:

- Character (Char.)
- Numeric (NR, NR1, NR2, NR3)
- String (String)
- Binary block (Block), see appendix 8.2.

2.4. INTERFACE PUSHKEYS AND LEDS

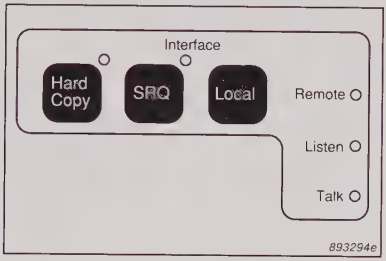

Fig. 2.7. Interface pushkeys and LEDs

2.4.1. Hard Copy

Before attempting to obtain a printout using the **"Hard Copy"** key, the desired printer format must be selected from Page 3 the I/O Interface Menu (see Fig. 2.8).

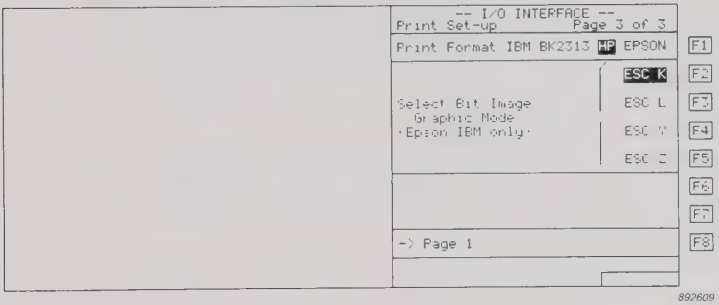

Fig. 2.8. Page 3 of I/O Interface Menu

When the **"Hard Copy"** key is pressed the analyzer goes into talk mode, and lights the **"Hard Copy"** and **"Talk"** LEDs (Unless the **"Hard Copy"** LED is already lit, or the analyzer is adressed over the interface).

A copy of the screen is then read out to the printer via the IEEE 488 or RS–232–C interface (depending on which of them is currently selected). If **"Hard Copy"** is pressed again while the LED is still lit, the readout is interrupted and the analyzer leaves talk mode.

When the readout is complete, or if it is interrupted, the **"Hard Copy"** and **"Talk"** LEDs are turned off. Pressing **"Hard Copy"** again after this starts a new readout.

The readout is a true raster copy of the current analyzer screen. If the interface is INACTIVE when **"Hard Copy"** is pressed, then it is activated automatically, and de-activated again when the printout is completed.

2.4.2. SRQ

When the **"SRQ"** key is pressed, the analyzer sends a Service Request if:

- The IEEE interface is set to ACTIVE in the I/O interface Menu, and
- This function is enabled in the SRQ mask (see section 6.1).

The **SRQ** LED indicates that the analyzer is waiting to be serviced by the controller. It is lit when one or more of the conditions defined in the SRQ mask are satisfied. It is switched off again when the controller carries out a serial poll on the analyzer.

2.4.3. LOCAL key and REMOTE LED

When a controller addresses the analyzer as a LISTENER, it can put the analyzer into the **Remote** state. It does this if the REN (Remote Enable) line was set to TRUE prior to the addressing. When this happens the **Remote** LED is lit and the normal operation of the front panel keys is inhibited. When the analyzer is in **Remote** mode, all the analyzer keys are inoperative, with the exception of: **"Local"**, **"Reset"**, **"Power On/Off"**, **"Viewing Angle"**, **"X-axis Scroll"**, **"Y-axis Scroll"**, **"SRQ"** and **"Display Backlighting On/Off"** (back panel).

The analyzer returns to **Local** mode when:

- The **"Local"** key is pressed, or
- The REN line is (re)set to FALSE

The **Remote** LED is then switched off, and all the manual keys work normally again.

Notes:

- If the controller, using the bus command LLO (local lockout), has put the analyzer into the LOCAL LOCKOUT mode, then the **"Local"** key has no effect. In this case the controller, using the bus command GTL, can put the 2143 into the LOCAL WITH LOCKOUT mode. In this mode the front panel operates normally.

- The RS–232–C has no REN line, and the bus command LLO cannot be used. In this case the **Remote/Local** function is implemented using the messages **REM** and **LCK**. See sections 6.12 and 6.13 for further details.

2.4.4. LISTEN and TALK LEDS

IEEE 488

The **Listen** LED lights when the analyzer is addressed as a **Listener**. It happens when:

- The analyzer is addressed by a controller, or
- Soft Key **"F5"**, `Listen only`, on page 1 of the I/O interface menu is pressed.

The **Listen** LED is switched off again when the 2143 is unaddressed. This can occur in several different ways:

- A controller sets the IFC (interface clear) bus line.
- Unaddress is received from a controller (address 31).
- The analyzer is addressed as a **Talker**.
- The **"Hard Copy"** key is pressed a second time (see section 2.4.1 above).
- The interface is made `INACTIVE`.
- The soft key **"F5"** is pressed a second time (see section 2.4.6).

The **Talk** LED lights when the 2143 is addressed as a **Talker**. It happens when:

- The analyzer is addressed by a controller, or
- When a printout is started by using the **"Hard Copy"** key.

The **Talk** LED is switched off again when the 2143 is unaddressed. This can occur in several different ways:

- A controller sets IFC.
- Another talk address is received from a controller.
- The analyzer is addressed as a **Listener**.
- The **"Hard Copy"** key is pressed for a second time.
- The interface is made `INACTIVE`.

RS 232-C

The **Listen** LED indicates when data is received. It is lit when the analyzer recognises the first character of a header. It is switched off when reception of a command string has been completed, i.e. terminated with <LF>.

The **Talk** LED indicates when data is being transmitted. This transmission is initiated either by a command received via the interface, or by **"Hard Copy"** being pressed. The LED is switched off again when transmission is completed.

2.4.5. Show Status (Soft Key F3)

Refer to Fig. 2.9.

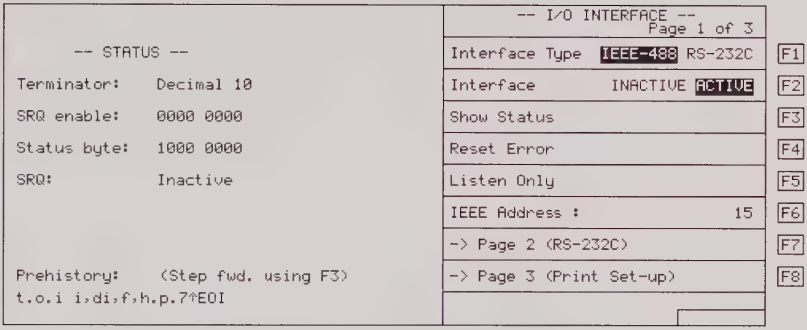

Fig. 2.9. Page 1 of I/O Interface Menu after Soft Key F3 is Pressed

Terminator: indicates the decimal value of the chosen terminator (default = 10 i.e. ASCII <LF>).

SRQ enable: Indicates the bit pattern for the status mask.

Status byte: Indicates the bit pattern for the status byte.

SRQ: can be either Active or Inactive.

Prehistory: Prehistory: (step forward using F_3) is only displayed if **E**ror_**S**top **Y**es is chosen, when the log buffer is empty. See **E**rror_**S**top, section 6.3.

t.o.i. etc is the contents of the log buffer (see 3.4 and 6.3).

2.4.6. Listen Only (Soft Key F5)

This key has no effect when the RS–232–C has been selected, as the listen function is always active.

With the IEEE interface, pressing **"Listen Only"** causes the analyzer to go into "Listen Only" Mode. In this mode the LISTEN LED is lit, and the analyzer functions as a listener until:

- Soft Key **"F5"** is pressed again, or
- The Controller sets the IFC line, or
- The analyzer is addressed as a TALKER
- A Controller sends MTA or UNL

2.5. MESSAGE CANCELLATION

A message can be cancelled by the controller by:

- Sending Device Clear or Selective Device Clear, or
- Sending the **RES**et Message via the interface.

A message can be cancelled manually from the 2143 front-panel controls by:

- Pressing Interface INACTIVE, or
- Pressing **"Reset"**

2.6. ERROR CANCELLATION

A digital I/O error on the IEEE 488 interface can be cancelled by the controller by:

- Sending Device Clear (DCL) or Selective Device Clear (SDC), or
- Conducting a Serial Poll if the SRQ mask bit for I/O errors has been set

A digital I/O error can be cancelled manually by:

- Pressing interface INACTIVE, or
- Pressing **"Reset"**

Note: Pressing INACTIVE will deactivate the Interface.

See section 3.4 for a description of RS–232–C error cancellation.

A list of all the interface error messages can be found in the Appendix in Chapter 8.

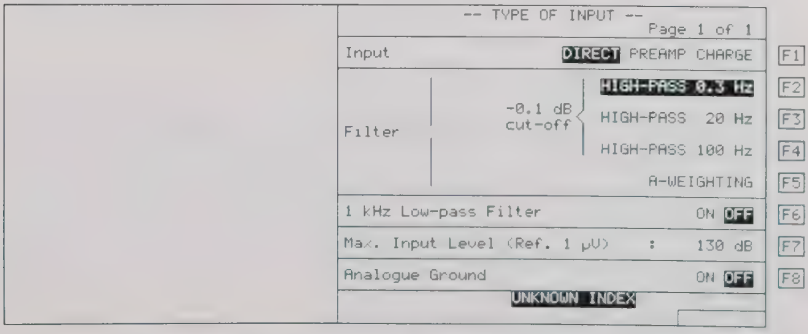

Fig 2.10. The 2143 displaying an interface error message

2.7. LEVELS OF RESET

The interface has three levels of reset:

1. **Interface Clear (IFC)** - All devices connected to the bus are unaddressed.
2. **Device Clear (DCL)** - Sent by a controller. Parsing is restarted for all connected devices*.
3. **RES**et - This has a similar effect to a manual reset.

Note: Parsing is the compiler operation of identifying the elements of instructions in terms of the programming language.

2.8. MESSAGE DESCRIPTION

The 2143 interface messages can be divided into 4 groups each dealing with a particular type of data transfer. The messages are listed in Table 2.2 and described in chapters 4, 5, 6, and 7.

*Selected Device Clear (SDC) restarts parsing for all devices addressed as listeners

Group	Message name	Section
Key control	**Key_C**ontrol **RES**et	4.1 4.2
Setup	**T**ype_**O**f_**I**nput **F**ilter_**B**andwidth **C**alibration **AV**eraging **D**isplay_**M**ode **H**old **S**pectrum_**W**eighting **D**efined_**W**eight_**F**unction **R**eal_**T**ime_**C**lock **W**ake_**U**p **M**easurement_**T**ext_**P**redefine **M**easurement_**T**ext_**S**elect **T**rigger **P**reselected_**SE**tup	5.1 5.2 5.3 5.4 5.5 5.6 5.7 5.8 5.9 5.10 5.11 5.12 5.13 5.14
Device Control	**S**ervice_**R**equest_**E**nable **D**efine_**T**erminator **E**rror_**S**top* **R**eset_**S**tatus_**B**yte **ID**entify? **U**pdate **AW**ait** **A**veraging_**M**ode **A**veraging_**C**ontrol **M**easurement_**M**ode **M**ax_**I**nput **REM**ote† **LoCK**out	6.1 6.2 6.3 6.4 6.5 6.6 6.7 6.8 6.9 6.10 6.11 6.12 6.13
Status Input/Output	**E**rror? **S**tatus_**B**yte? **A**veraging_**S**tatus	7.1 7.2 7.3
Result Input/Output	**S**pectrum_**D**ata **S**pectrum_**M**emory_**R**eading? **C**urrent_**S**pectrum_**R**eading?	7.4 7.5 7.6
Display Input/Output	**P**rint_**SC**reen?	7.7

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* Different effect with IEEE 488 and RS–232–C
** Cannot be used with RS–232–C interface
† RS–232–C only

Table 2.2. Overview of 2143 interface messages

3. RS–232–C INTERFACE

3.1. INTRODUCTION

The Serial Interface of the 2143 conforms to the EIA standard RS–232–C (equivalent to CCITT V 24). The 2143 is coupled as a "Data Terminal Equipment" (DTE) and has a 25-pin male D-range connector, marked **Serial Bus (RS–232–C)**, situated on the back panel. Normally, to connect the 2143 to another DTE, such as a PC, a modem is used. If the 2143 is to be connected directly to another DTE, then a special type of cable is required, so that the DTEs appear to each other to behave like modems. This cable is called a "null-modem". An example of null-modem cross connections which may be used with the 2143 is given in Fig. 3.1.

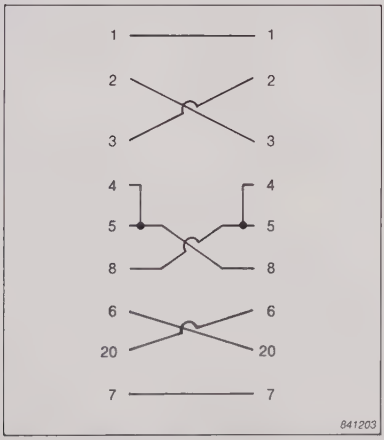


Fig. 3.1. Null-modem connection details

3.2. THE SERIAL AND PARALLEL INTERFACES

The RS–232–C interface of the 2143 is a serial interface, consisting, in its basic form of three lines:

1. Transmitted Data.
2. Received Data.
3. Signal Ground.

There are considerable functional differences compared to the IEEE 488 interface, which besides being a parallel interface, also has a number of dedicated control lines. Specific differences in the individual messages are described in the relevant sections in the following chapters, but a brief description of some of the principal RS–232–C functions, where they differ, is given below. Fig. 3.2 shows Page 2 of the I/O Interface Menu, where the various RS–232–C options may be selected

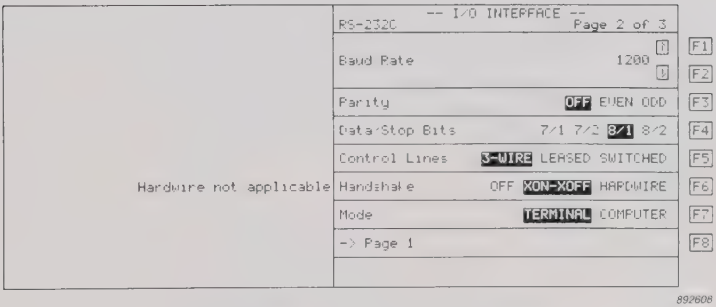


Fig. 3.2. Page 2 of I/O Interface Menu

3.2.1. Serial Data Formats

In Page 2 of the I/O Interface Menu the data format is selected using soft keys **"F1"**, **"F2"**, **"F3"** and **"F4"**. These determine the baud rate, the parity and the number of data/stop bits.

Baud Rate
The baud rate is set using soft keys **"F1"** and **"F2"**.

Parity (soft key "F3")
- OFF - No parity bit is generated or checked
- EVEN - An even parity bit is generated and checked
- ODD - An odd parity bit is generated and checked

Data/Stop Bits (soft key "F4")
- 7 Data bits give faster transmission, but cannot be used for binary data, e.g. Hard Copy
- 8 Data bits is applicable to any data type
- 1 Stop bit gives faster transmission
- 2 Stop bits give better data security in noisy environments

3.3. MESSAGE FORMAT

The same message format is used for programming both the IEEE and RS–232–C interfaces. Differences in individual messages are described in the relevant section for that message, e.g. **E**rror_**S**top section 6.3.

3.4. ERROR HANDLING

If an error is detected, an error message is displayed on the screen, and an X-Off is sent to allow time for a buffer change (see also section 3.6). From then on all input is ignored until:

- The **"Local"** key is pressed, or
- A BREAK is received.

If **E**rror_**S**top **Y**es is selected, the incoming data is logged into the log buffer, until it is full. This data can be recalled sequentially by pressing the Soft Key **Show Status**, **"F3"** on Page 1 of the I/O Interface menu (see also sections 2.4.5 and 6.3).

If data starts to come in while transmission is taking place, the error message JOB IS CANCELLED is displayed, and the transmission is cancelled. The analyzer then switches over to receive and starts to parse the incoming data.

Note: The handshake characters are not regarded as incoming data while transmission is taking place (see 3.8).

3.5. RESET ERROR (Soft Key F4)

Pressing **"F4"** on page 1 of the I/O Interface menu is used to restart parsing after an error has been received.

3.6. THE STATUS BYTE

The status byte can only be read out using the output message **S**tatus_**B**yte**?** (see section 6.2), as it is not possible to perform a serial poll via the RS–232–C interface. As the **S**tatus_**B**yte**?** message does not affect any of the bits in the status byte, you must ensure that it is reset to zero by using the message **R**eset_**S**tatus_**B**yte (see section 6.4).

Note: The busy bit (bit 5) will always be set when the status byte has been read out. This is because the analyzer is "busy" generating data at the instant the readout occurs.

3.7. ABORTED TRANSMISSION

If Ctrl C is received while transmission is taking place, transmission stops. The remaining data for transmission is discarded and the analyzer switches over to receive.

3.8. HANDSHAKING

3.8.1. Handshaking Requirements

The 2143 has 2 input buffers, each containing 128 bytes. During data reception these are used alternately, so that one can receive the incoming data while the contents of the other are processed. The analyzer switches between these buffers as often as possible. However, it is still necessary to use handshaking at fast data reception rates, to avoid "overflow" because there is not enough time for switching.

There are three different handshake modes (selected using soft key **"F6"** in page 2 of the I/O interface menu).

1. **Off** - When data is received the X-Off character is not sent, even when the input buffer in use is about to overflow. When data is transmitted, transmission stops if X-Off is received. Transmission resumes when X-On is received.

2. **X-On/X-Off** - When receiving data, X-Off is sent when there are only 27 free bytes left in the input buffer. X-On is sent when the analyzer has changed buffers (i.e. when there are 128 bytes free again). X-On is also sent when the interface is switched to ACTIVE (soft key **"F2"** in page 1 of I/O Interface menu). When transmitting, the analyzer pauses if X-Off is received. Transmission resumes when X-On is received.

3. **Hardwired** - When receiving data, DTR is set to Off when 27 bits are left in the input buffer. DTR is set to On again when the analyzer has changed buffers. When transmitting, the analyzer pauses if:

   - X-Off is received: Transmission resumes when X-On is received, or
   - DSR changes to OFF: Transmission resumes when DSR returns to ON.

3.8.2. Handshake Timing Considerations

When the handshake characters X-On (DC1 or decimal 17) and X-Off (DC3 or decimal 19) are received during data transmission, they are always treated as data.

To avoid an interface lock-up due to an X-On being received during data reception, the 2143, when it begins to transmit, always behaves as if it has received an X-On. This is always the case, regardless of whether the transmission was started by an interface command or manually. This problem does not exist with hardwired handshaking.

3.9. CONTROL LINES

These functions depend on the choice of the Control Lines parameter on page 2 of the I/O Interface menu (soft key **"F5"**), and to some extent on the type of handshake chosen.

3.9.1. 3-Wire

The RTS and DTR lines remain inactive. The CTS, DSR and DCD lines are ignored.

3.9.2. Switched

The two output control lines, DTR and RTS, are always set to ON when the RS–232–C Interface is set to ACTIVE (soft keys **"F1"** and **"F2"** in the I/O Interface menu, page 1). They remain ON until the interface is again made INACTIVE. See also section 3.8.1. for use of DTR with hardwired handshake

CTS Off inhibits transmission of data. Transmission resumes if CTS switches to On. The function of DSR and DTR depends on the type of handshake chosen:

- **Off** or **X-On/X-Off** - DSR Off during transmission causes transmission to cease, and the error message DSR OFF is displayed.
- **Hardwired** - Function described under Handshake, section 3.8.1.

3.9.3. Leased

RTS, DTR, CTS and DSR work in a similar way to **Switched**. If DCD is OFF it inhibits the reception of incoming data (the analyzer discards the incoming data as faulty, but without generating an error message).

3.10. COMPUTER AND TERMINAL MODES

The COMPUTER or TERMINAL modes may be selected using Soft Key **"F7"**, on page 2 of the I/O Interface Menu.

3.10.1. Terminal Mode

In this mode, which is intended for use with a "dumb" terminal, every printable character is retransmitted as soon as it is received (echo). A prompt is transmitted whenever the analyzer is ready to receive a new message.

This prompt is: "< CR >< LF >$"

There is also a simple screen editor.

Example:

When the RS–232–C interface is activated, the prompt is sent, and the terminal screen shows:

```
$■
```

After executing the message "S_R_E? <CR><LF>", the screen shows.

```
$ S_R_E?
S_R_E 0

$■
```

Editing Functions - In Terminal mode, the analyzer stores input data (characters) in its input buffer. When the buffer is full (132 characters), or when a <LF> is received, the buffer contents are processed and the buffer is cleared. The buffer can also be cleared manually.

The last character received in the buffer can be deleted by sending <BS> o <DEL> to the analyzer. When this happens the cursor on the terminal screen moves one space to the left, but does not delete the character on the screen. This can be repeated as many times as there are characters in the buffer.

Notes:

- If a character string is typed in which is so long that it runs onto a new line, then the cursor cannot be moved back to the previous line by using <BS>. However, a character is still deleted in the input buffer for each subsequent keystroke.

- Entering block data in terminal mode is not recommended. However it is possible, provided that the data does not contain <LF>, <BS> or <DEL> and the total length of the input string < 132 characters.

3.10.2. Computer Mode

In this mode the analyzer is connected to an intelligent controller. Neither echo nor prompt are transmitted and it is not possible to edit transmitted data.

4. KEY CONTROL MESSAGES

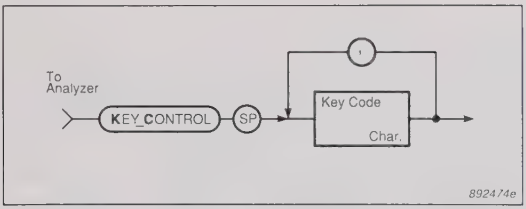
4.1. RESET

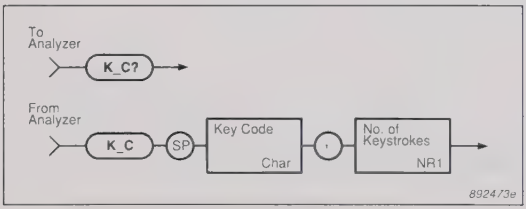
RESet (input only) is used to reset the analyzer via the interface bus. This has the same effect as a manual reset, and unaddresses the interface. To reset the IEEE interface, the IEEE **DCL** command is used.

4.2. KEY_CONTROL

Key_**C**ontrol is used to perform one of more of the "remote keystrokes" listed in Table 4.1. This has the same effect as pressing the corresponding key(s) on the front panel of the analyzer.

The output message, **K_C?**, returns a readout of the code for the last front-panel key operation, and the number of keys pressed since the last readout or reset (via the front panel or the bus).





Notes:

- Certain front-panel functions – **"Power On/Off"** and **"Reset"** – cannot be performed using this message.

- Remote control of the `Memory` and `Autosequence` menus is not recommended, as it may be difficult to anticipate all the consequences of a particular series of keystrokes.

Key Control Codes	
Key	**Code**
Main Menu	**MA_M**
Meas. Mode	**ME_M**
F1 to F8	**F1 to F8**
Next Menu	**N_M**
Prev. Page	**P_P**
0	**N0**
1	**N1**
2	**N2**
3	**N3**
4	**N4**
5	**N5**
6	**N6**
7	**N7**
8	**N8**
9	**N9**
.	**D_P**
Clear	**CL**
Recall	**REC**
k	**K**
m	**M**
+/–	**C_S**
Autoseq. Stop/Step	**A_S_S**
Trigger Manual	**T_M**
Averaging Mode Lin.	**A_M_L**
Averaging Mode Exp.	**A_M_E**
Averaging Start	**A_STA**
Averaging Proceed	**A_P**
Averaging Stop	**A_STO**
Max. Input Up	**M_I_U**
Max. Input Down	**M_I_D**
Viewing Angle Up	**V_A_U**
Viewing Angle Down	**V_A_D**
Ampl. Scroll Up	**A_S_U**
Ampl. Scroll Down	**A_S_D**
Freq. Scroll Up	**F_S_U**
Freq. Scroll Down	**F_S_D**
Back Lighting On/Off	**B_L**
Hard Copy	**H_C**
SRQ	**SRQ**
Local	**L**

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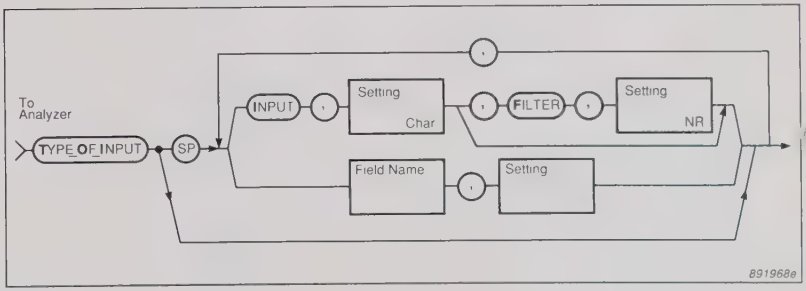
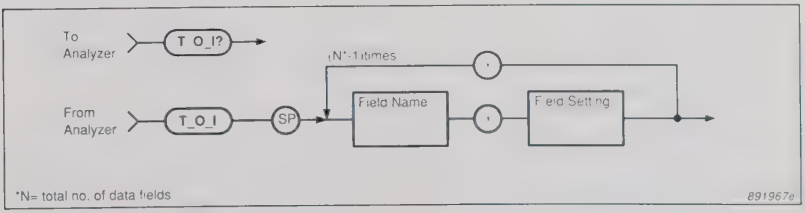
Table 4.1. Key_Control pushkeys and codes

5. SETUP MESSAGES

5.1. TYPE_OF_INPUT

This is used to set one or more of the **T_O_I** data fields and display the **T**ype_**O**f_**I**nput menu. The output message returns a readout of all current **T_O_I** data fields. The data fields and their settings are listed in Table 5.1.





Field Name	Field Setting	Data Type	Comments
Input	**DI**rect **PR**eamp **CH**arge	Char.	 Not with A_Weighting
Filter	**H**igh_**P**ass_**0.3** **H**igh_**P**ass_**2**0 **H**igh_**P**ass_**1**00 **A**_**W**eighting	Char.	Also choose H_P_0.3 for PReamp Not with CHarge
Low_**P**ass	**ON** **OF**f	Char.	
Max_**I**nput_**L**evel	<numeric>	NR	
Analogue_**G**round	**ON** **OF**f	Char.	

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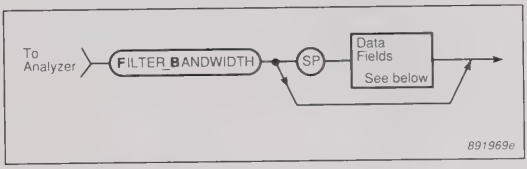
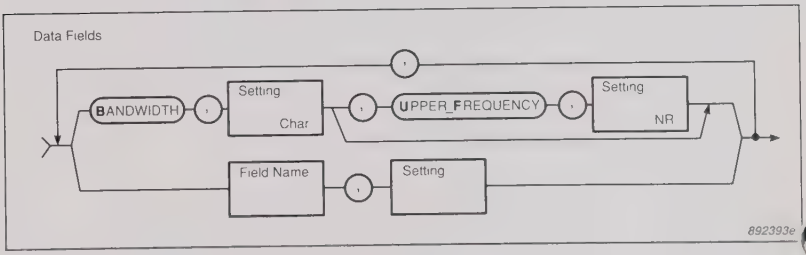
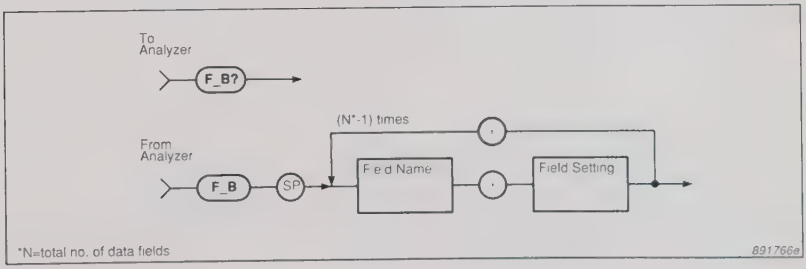
Table 5.1. Type of Input data fields and codes

5.2. FILTER_BANDWIDTH

This is used to set one or more **F_B** data fields and to display the **F**ilter_**B**andwidth menu. The output message returns a readout of all current **F_B** data fields. Fig. 5.1 shows allowable combinations of **B**andwidth and **U**pper_**F**requency. The data fields and their settings are listed in Table 5.2.







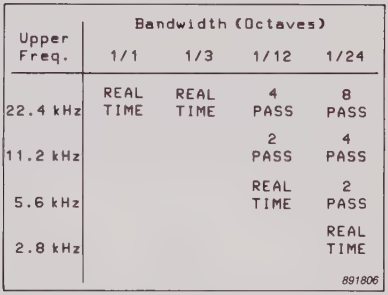


Fig 5.1. Allowable combinations of bandwidth and upper frequency

Field Name	Field Setting	Data Type	Comments
Bandwidth	**O**ctave_**1** **O**ctave_**3** **O**ctave_**1**_**2** **O**ctave_**24**	Char.	See fig. 3.3 for allowable combinations of B and U_F
Upper_**F**requency	2.8;5.6;11.2; 22.4 kHz	NR (with suffix)	
Multi_**P**ass_**A**nalysis	**AU**to **MA**nual	Char.	
Lowest_**R**eliable_ **F**requency	10 mHz–100 Hz	NR (with suffix)	
Time_**I**nterval_ **B**etween_**P**asses*	—	NR	Not settable, value depends on L_R_F setting

* Exists as input message, but has no effect

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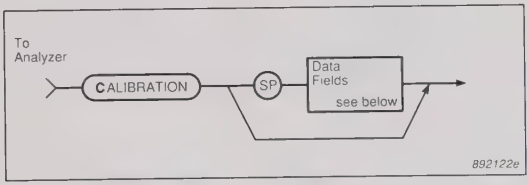
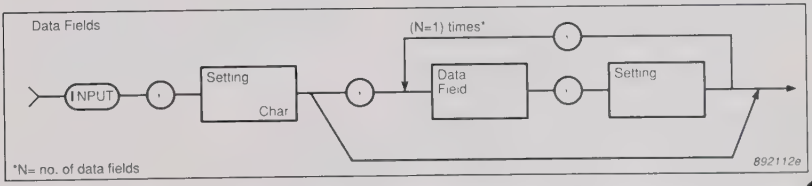
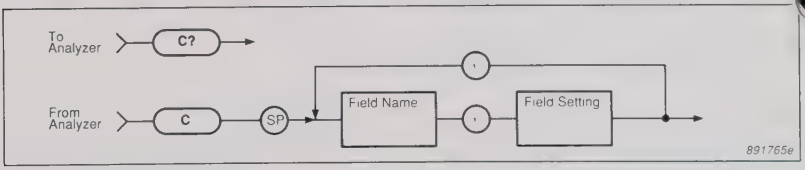
Table 5.2. Filter Bandwidth data fields and codes

5.3. CALIBRATION

This is used to set one or more specified **C** data fields and display the **C**alibration menu. The output message returns a readout of current **C** data fields for all three inputs (with the exception of **A**uto_**C**alibration, **C**alibration-_**A**veraging_**T**ime and **Y**_**A**xis_**U**nit). The data fields and their settings are listed in Table 5.3.







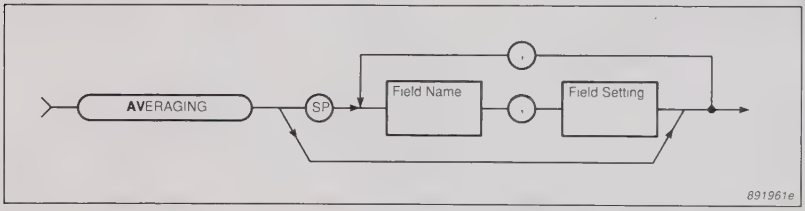
Field Name	Setting	Data Type	Comments
Input	**DI**rect **PR**eamp **CH**arge	Char.	
Calibration_**L**evel		NR	
Calibration_**F**requency		NR	
Transducer_**SE**nsitivity		NR	
Gain_**A**djustment		NR	
Calibration_**A**veraging_**T**ime	2; 4; 8; 16	NR1	Time in seconds
Auto_**C**alibration	**STA**rt	Char.	
Y_**A**xis_**U**nit	**DB** **AB**solute	Char.	

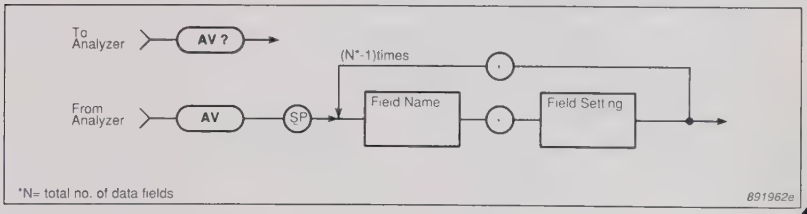
T02286GB0

Table 5.3. Calibration data fields and codes

5.4. AVERAGING

This is used to set one or more specified **AV** data fields and display the **AV**eraging menu. The output message returns a readout of all current **AV** data fields. The data fields and their settings are listed in Table 5.4.





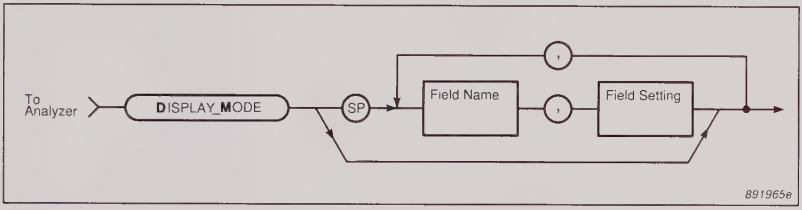
Field Name	Field Setting	Data Type	Comments
Averaging_**M**ode	**L**inear **EX**ponential	Char.	
Lin_**A**vg_**T**ime	1 **MS** to 24 **H**rs	NR (with suffix)	Default is seconds If units other than seconds are required, the suffixes H, M and MS can be used
Exp_**A**vg_**T**ime	1/512 to 512 s	NR	Time in seconds. Internal values must be whole powers of 2

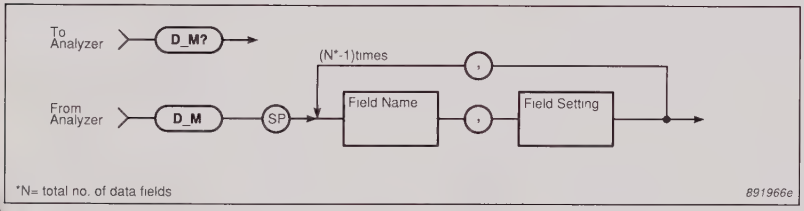
T02291GB0

Table 5.4. Averaging data fields and codes

5.5. DISPLAY_MODE

This is used to set one or more specified **D_M** data fields and to display the **D**isplay_**M**ode menu. The output message returns a readout of all current **D_M** data fields. The data fields and their settings are listed in Table 5.5.





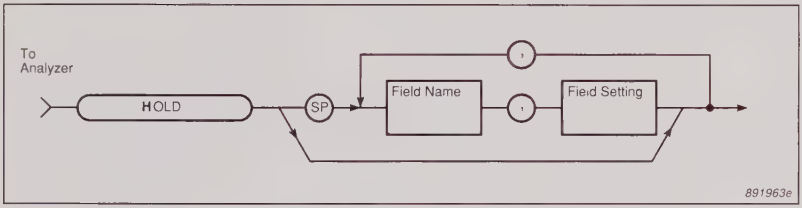
Field Name	Setting	Data Type	Comments
Mode_Options	SIngle DUal DIfference	Char.	
Y_Axis_Unit	DB ABsolute	Char.	
Highest_Centre_Frequency		NR (with Suffix)	
Lowest_Centre_Frequency		NR (with suffix)	
Full_Scale_Input		NR	
Full_Scale_Recalled		NR	
Displayed_Range_Input Displayed_Range_Recalled	10;20;40;80	NR1	
Displayed_Range_Diff	1;5;10;20;40;80	NR1	
Spectrum_Unit_Input Spectrum_Unit_Recalled	ENg RMs PWr PSd ESd	Char.	
Differentiationor_Integration_Input Differentiationor_Integration_Recall	Differentiated_Twice DIfferentiated None Integrated Integrated_Twice	Char.	

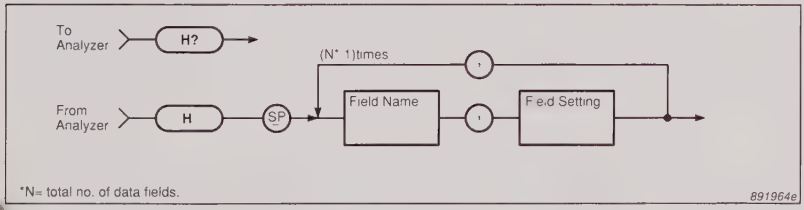
T02233GB0

Table 5.5. Display Mode data fields and codes

5.6. HOLD

This is used to set one or more specified **H** data fields and display the **H**old menu. The output message returns a readout of all current **H** data fields. The data fields and their settings are listed in Table 5.6.





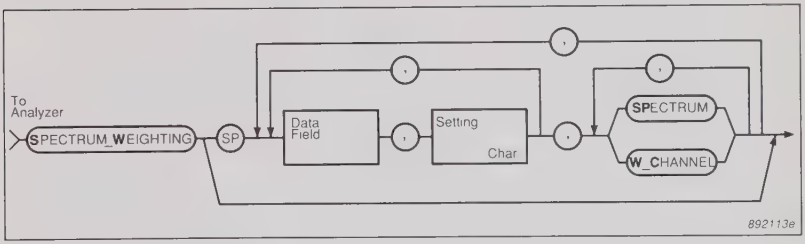
Field Name	Field Setting	Data Type	Comments
Type	**MA**x **MI**n	Char.	
MOde	**D**ata_**E**xclude **A**ll_**C**hannels **A**_**L**_**C**hannel **W**_**C**hannel **B**and_**P**ass_**F**ilter	Char.	
Band_**P**ass_**F**ilter_ **C**entre_**F**requency		NR (with suffix)	Automatically rounded to nearest centre frequency

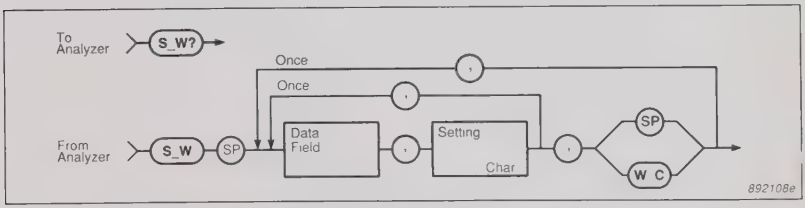
T02245GB0

Table 5.6. Hold data fields and codes

5.7. SPECTRUM_WEIGHTING

This is used to set one or more specified **S_W** data fields and display the **S**pectrum_**W**eighting menu. The output message returns a readout of all current **S_W** data fields. The data fields and their settings are listed in Table 5.7.





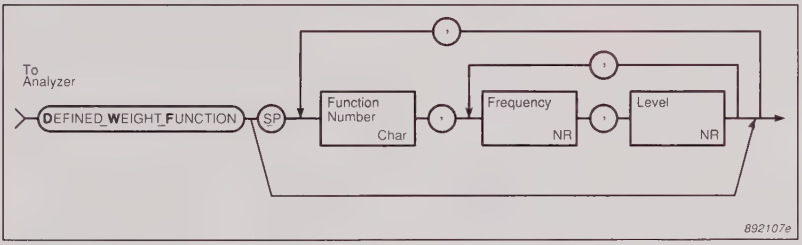
Field Name	Setting	Data Type	Comments
Weight	**L**inear_**W**eighting **U1** **U2** **U3** **U4** **A_W**eighting **B_W**eighting **C_W**eighting **D_W**eighting	Char.	
Inverse	**ON** **Off**	Char.	
[ADD TO]	**SP**ectrum **W_C**hannel	Char.	[ADD TO] is not a code i.e. settings only are used

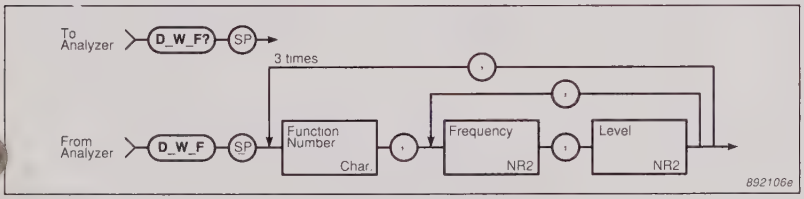
T02355GBC

Table 5.7. Spectrum Weighting data fields and codes

5.8. DEFINED_WEIGHT_FUNCTION

This is used to enter a given weight function by a method corresponding to manual entry, via Page 2 of the **Spectrum_Weighting** menu. **D_W_F** without any data field(s) displays Page 2 of the **Spectrum_Weighting** menu. The output message returns a readout of all user-defined weight functions.



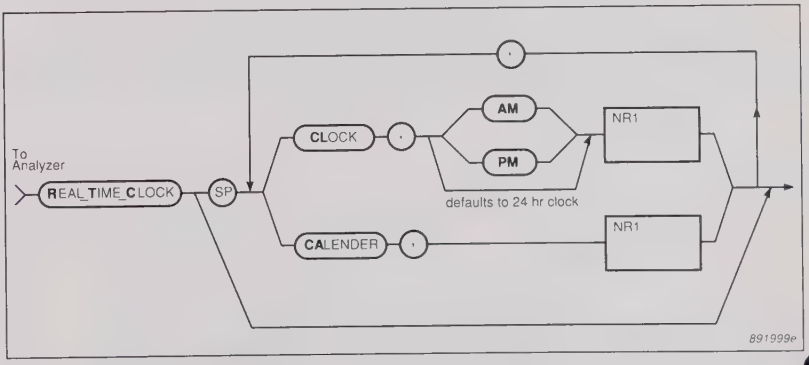


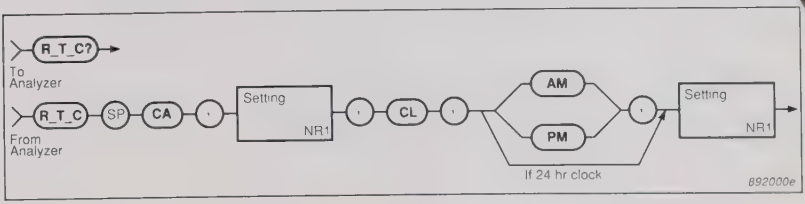
Note: Function number can be **U1**, **U2**, **U3** or **U4**.

5.9. REAL_TIME_CLOCK

This is used to display page 2 of the **R**eal_**T**ime_**C**lock menu and set the 'Clock' data fields. The output reads out all current Clock data fields. The data fields and their settings are listed in Table 5.8.

Note:
Data fields concerned with **W**ake_**U**p functions are described in section 5.10.





Field Name	Field Setting	Data Type	Comments
CAlender	<integer>	NR 1	YYYYMMDD
CLock	**AM**, <integer> **PM**, <integer> <integer>	Char. NR 1	HHMMSS Integer only defaults to 24 hr clock.

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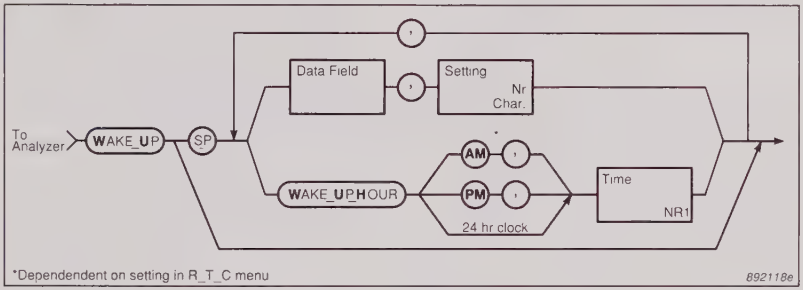
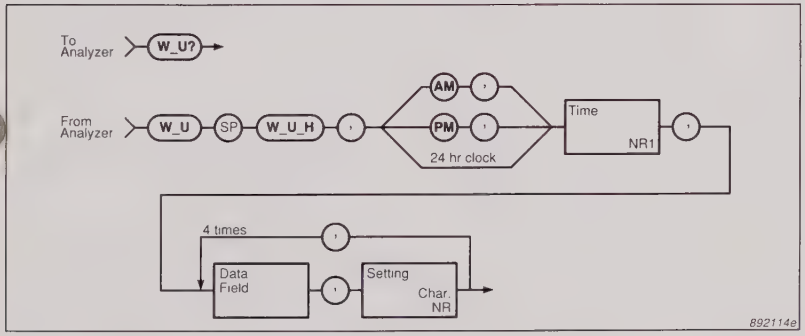
Table 5.8. Real Time Clock data fields and codes

5.10. WAKE_UP

This is used to set the **W_U** data fields in the **R**eal_**T**ime_**C**lock menu and display Page 1 of the menu. The output message returns a readout of all **W**ake_**U**p data fields. The data fields and their settings are listed in Table 5.9.





Note: If **W**ake_**U**p is set to **AC**tive, 10 seconds elapses, then the 2143 switches itself off and consequently deactivates the interface. When the 2143 "wakes up" again it will not automatically reactivate the interface.

Field Name	Field Setting	Data Type	Comments
Wake_**U**p_**H**our	**AM**, <integer> **PM**, <integer> <integer>	Char. NR1	<HHMM> Depends on R_T_C setting. Nothing defaults to 24 hr clock
Repetition_**I**nterval	1 **M**inute to 24 **H**ours	NR (with suffix)	Minutes expressed as decimal fractions of an hour, e.g. 1.5 H = 1 hr 30 min. 90 M = 1 hr 30 min. Default is hours
Numberof_**W**ake_**U**ps	1–9999	NR1	Sets no. of "wake ups"
Wake_**U**p	**AC**tive **I**nactive	Char.	See note
Elapsed_**N**umberof_ **W**ake_**U**ps	0–9999	NR1	Exists as input message, but has no effect

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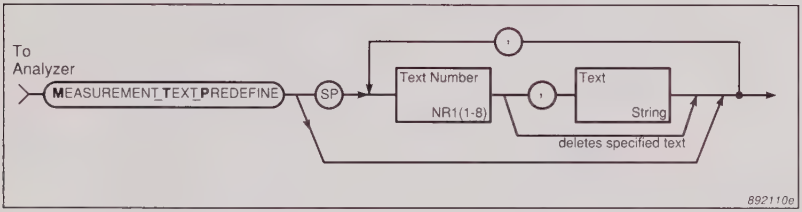
Table 5.9. Wake Up data fields and codes

5.11. MEASUREMENT_TEXT_PREDEFINE

Measurement_**T**ext_**P**redefine is used to edit the text fields of the **M**easurement_**T**ext menu, and to display Page 2 of that menu. The output message returns a readout of all text fields in the Measurement Text menu. The data fields and their settings are listed in Table 5.10.



Example:
To enter the first text field, the controller sends:

M_T_P 1,"ABCDEF"

Data Field	Data Type
Text No.	NR1
Text	String*

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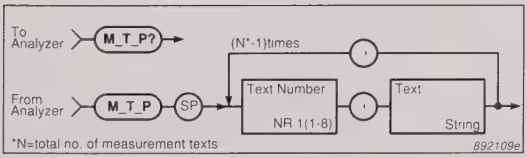
* Max. 40 char.

Table 5.10. Measurement Text Predefine data fields



Example:
To obtain a readout of the text fields, the controller sends:

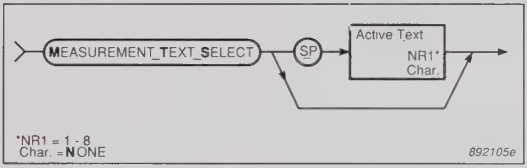
M_T_P?

The analyzer responds with:

```
M_T_P 1,"ABCDEF          ",2,"GHIJKL          ",3,"
```

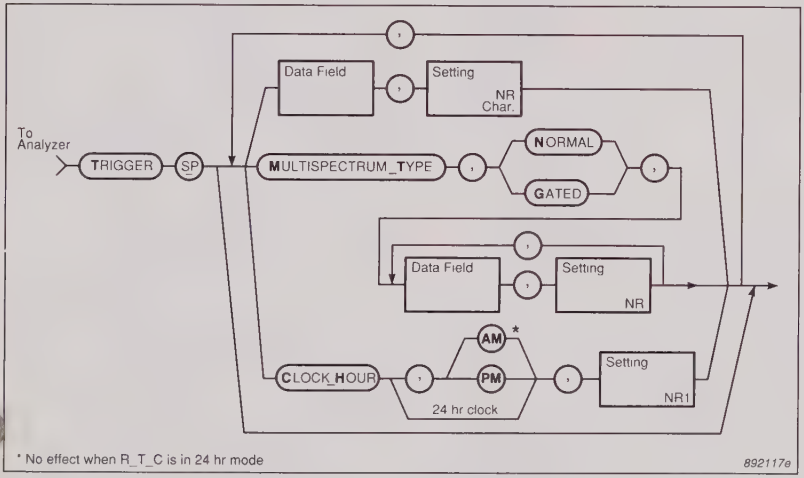
5.12. MEASUREMENT_TEXT_SELECT

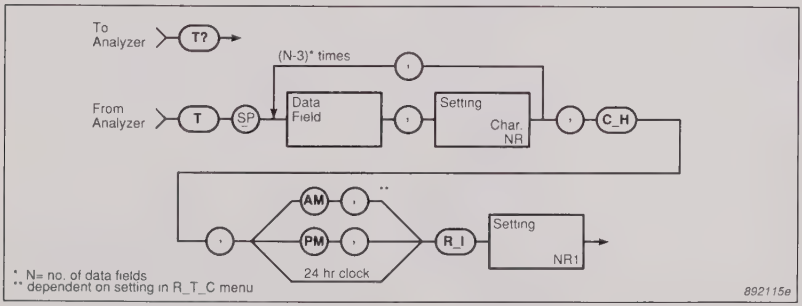
Measurement_**T**ext_**S**elect is used to select one of the predefined texts from the **M**easurement_**T**ext menu, and to display Page 1 of that menu.



5.13. TRIGGER

This is used to set one or more specified **T** data fields and to display the **T**rigger menu. The output message returns a readout of all current **T** data fields, with the exception of **C**lock_**H**our and **R**epitition_**I**nterval. The data fields and their settings are listed in Table 5.11.





Field Name	Field Setting	Data Type	Comments
Trigger_**M**ode	**I**nactive **AC**tive	Char.	
Trigger_**SE**lect	**EX**ternal **I**nternal **T**ime **MA**naul **F**ree_**R**un	Char.	
Multispectrum_**T**ype	**N**ormal **G**ated	Char.	
Time_**D**elay		NR	Seconds. A negative value in 'Normal' = pretrig
Numberof_**S**pectraper_ **T**rigger		NR	
Time_**I**nterval_**B**etween_ **S**pectra		NR	Seconds Only applies to normal triggering
Gating_**W**idth		NR	Only applies to gated triggering
Numberof_**T**rigger		NR	Only applies to normal triggering
Trigger_**L**evel		NR	
Trigger_**C**hannel	**A_L_C**hannel **W_C**hannel **B**and_**P**ass_**F**ilter	Char.	
Band_**P**ass_**F**ilter_ **C**hannel_**F**requency	<numeric> { **MI** / **H**z / **K**Hz }	NR (with suffix)	Defaults to Hertz **MI** upper case, or lower case **m** for millihertz
SLope	**N**egative **PO**sitive	Char.	
Clock_**H**our	**AM**, <integer> **PM**, <integer> <integer>	Char. NR1	HHMMSS Integer only defaults to 24 hr clock
Repetition_**I**nterval	**M**inutes **S**econds	NR (with suffix)	default is seconds

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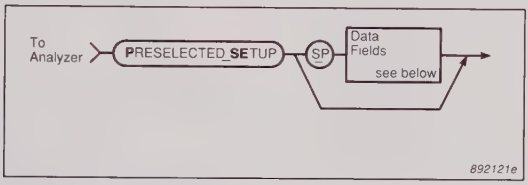
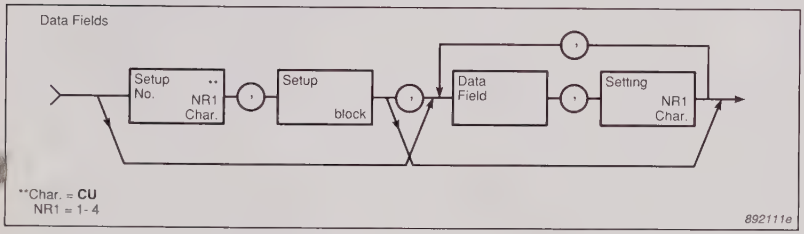
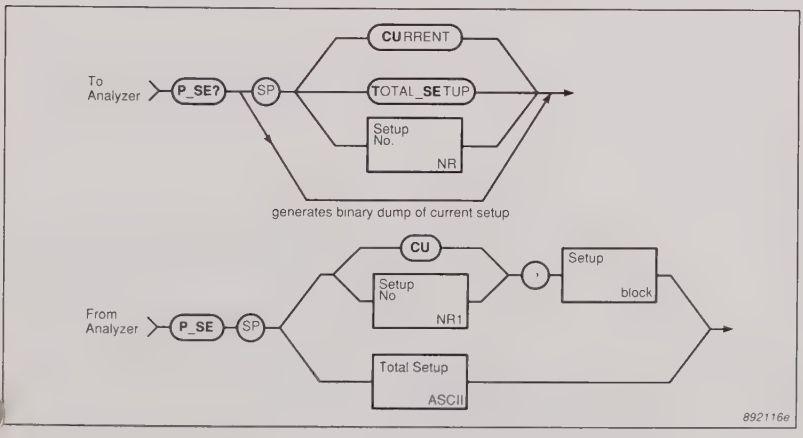
Table 5.11. Trigger data fields and codes

5.14. PRESELECTED_SETUP

This is used to read in or out a **P**reselected_**SE**tup in block data (binary) format and to change between the different Preselected Setups. It permits activation of the **ME**asurement setup, **DI**splay setup or the **CA**libration setup from either default values or a set of stored values. The output message returns a readout of a specified setup in binary or ASCII format. The data fields and their settings are listed in Table 5.12.







Header/Field Name	Field Setting	Data Type	Comments
CUrrent	—	—	Selects current setup
[NR1]*	**1; 2; 3; 4**	—	
[SETUP]*		Block	
SElect	**1** **2** **3** **4** **AC**oustic **V**ibration **SA**ved	NR1 Char.	
ACtivate	**ME**asurement **DI**splay **CA**libration	Char.	
Preselected_**SE**tup?**		Block	A specified (stored or current) setup is dumped in binary form.† Alternatively the current setup is read out in ASCII form

* Not codes
** Header
† Binary block data does not contain any data from the Wake_Up or I/O Interface menus

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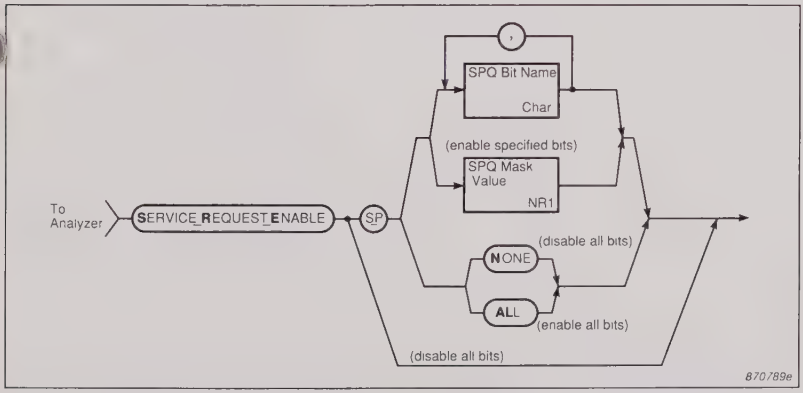
Table 5.12. Preselected SEtup data fields and codes

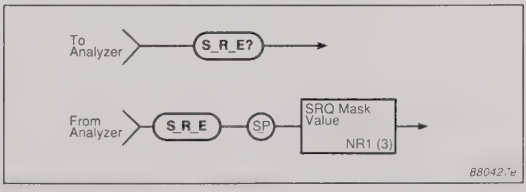
6. DEVICE CONTROL MESSAGES

6.1. SERVICE_REQUEST_ENABLE

The **S**ervice_**R**equest_**E**nable message is used to define the SRE mask. This determines which events generate a service request. Table 6.1 describes the 8 bits of the 2143 status byte. Table 6.2 lists the SRQ functions which relate to these, along with a brief explanation of their use.

Note: When the interface is made ACTIVE, all bits are disabled.





Bit no.	8	7	6	5	4	3	2	1
Binary Weighting	132	64	32	16	8	4	2	1
Designation	key pressed	service request	abnor-mal	busy	input overload	trigger accepted	power low	data available

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Table 6.1. The 2143 Status Byte

SRQ Functions			
Bit No.	**Bit Name**	**Data Type**	**Status Indication**
1	**D**ata_**A**vailable	Char.	Set when RMS processor finished[1] and latest data received by display
2	**P**ower_**L**ow	Char.	Set when battery voltage is low
3	**T**rigger_**A**ccepted	Char.	Set when triggering conditions are satisfied
4	**I**nput_**O**verload	Char.	Set when an analogue input overload occurs
5	[Busy][2]		Set if the analyzer has not finished processing the previous input message[3]
6	**AB**normal	Char.	Set when an error condition occurs
7	[SRQ][2]		Set by the analyzer if one of the other bits is set[3]
8	**K**ey_**P**ressed	Char.	Set if one of the analyzer's pushkeys has been pressed[4]
(1 to 8)	**AL**l **N**one	Char.	Enable all bits in the status byte Disable all bits in the status byte
–	[Bit Pattern][2]	NR1	Sets a selected combination of the above – NR1 is the decimal value of the bit pattern

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1 In the case of a multispectrum Data_Available is set when the last spectrum is finished
2 Not codes
3 Cannot be enabled by the user.
4 In REMote without local LoCKout (LLO), this bit is set only when local or SRQ keys are pressed. In REMote with LLO, the bit is set only when the SRQ key is pressed

Table 6.2. SRQ Functions

Example of Use:

SERVICE_REQUEST_ENABLE DATA_AVAILABLE,KEY_PRESSED

SERVICE_REQUEST_ENABLE 129

These two messages are equivalent, both set the mask bit pattern "10000001". The second message uses the decimal value of the bit pattern (1 + 128 = 129).

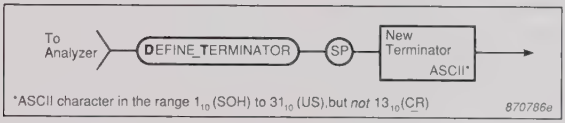
In this example the analyzer generates a service request:

- When it has finished processing the current data, and
- Whenever a key is pressed.

6.2. DEFINE_TERMINATOR

The **D**efine_**T**erminator message (input only) is used to define the ASCII character with which the analyzer terminates output messages, and which it recognises as the terminating character of input messages.

By default, i.e. unless user-defined, the terminator is the line feed character <LF>. All the ASCII control characters, with the exception of 13, or <CR> can be used as terminators. See Table 6.3 below.



Bit Numbers b_4 b_3 b_2 b_1	b_7 b_6 b_5 0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
0 0 0 0	NUL	● DLE	SP	0	@	P	‘	p
0 0 0 1	● SOH	● DC1	!	1	A	Q	a	q
0 0 1 0	● STX	● DC2	“	2	B	R	b	r
0 0 1 1	● ETX	● DC3*	#	3	C	S	c	s
0 1 0 0	● EOT	● DC4	$	4	D	T	d	t
0 1 0 1	● ENQ	● NAK	%	5	E	U	e	u
0 1 1 0	● ACK	● SYN	&	6	F	V	f	v
0 1 1 1	● BEL	● ETB	’	7	G	W	g	w
1 0 0 0	● BS	● CAN	(	8	H	X	h	x
1 0 0 1	● HT	● EM	)	9	I	Y	i	y
1 0 1 0	● LF	● SUB	*	:	J	Z	j	z
1 0 1 1	● VT	● ESC	+	;	K	[	k	{
1 1 0 0	● FF	● FS	,	<	L	\	l	¦
1 1 0 1	CR	● GS	–	=	M	]	m	}
1 1 1 0	● SO	● RS	.	>	N	‾	n	~
1 1 1 1	● SI	● US	/	?	O	_	o	DEL

* see note below

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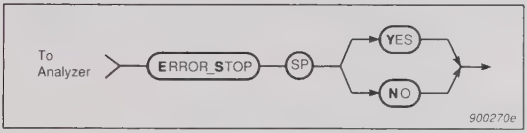
Table 6.3. ASCII characters. The allowed terminators are indicated by ●

Note: With RS–232–C operation it is not advisable to use <DC3>, ASCII 19, as the message terminator, as this provides the RS–232–C X-Off function.

6.3. ERROR_STOP

The **E**rror_**S**top message (input only) is used to determine what action the 2143 takes when an error is detected. The data field following the **E_S** header can be **Y**es or **N**o, determining whether or not the **E**rror_**S**top function is active.



- **Y**es – the 2143 stops the handshake with the (IEEE) bus, indicating to the connected controller that there is an error, or

- **N**o – it continues the handshake but ignores all subsequent data bytes received from the bus.

When **E**rror_**S**top **Y**es is selected, the effect is different for IEEE 488 and RS–232–C.

- **IEEE 488** - when an error is detected, the 2143 stops the hanshake with the bus, indicating to the controller that there is an error. After receiving a Device Clear (DCL) or Selected Device Clear (SDC), the 2143 resets the parser and resumes data reception. The same thing occurs if the 2143 is requesting service.

- **RS–232–C** - when an error is detected, the 2143 discards any character received except BREAK. After receiving a BREAK, parsing is resumed.

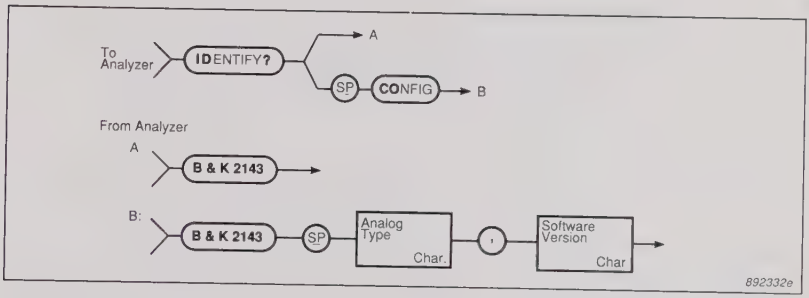
Note: When the interface is set to ACTIVE, **E**rror_**S**top is automatically set to **N**o.

6.4. RESET_STATUS_BYTE

The **R**eset_**S**tatus_**B**yte message (input only) is used to return the status byte to its default setting. In this way a service request can be cancelled without performing a serial poll. All the status byte bits are set to zero.

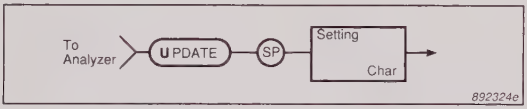
6.5. IDENTIFY?

IDentify**?** (output only) returns a readout of the instrument type. If version B of the message is sent, then the input module identification (analog type) and the software version number are also returned.



6.6. UPDATE

Update (input only) is used to choose the update mode for the 2143 display. The alternatives are listed in Table 6.4.



Field Name	Data Type	Comments
Update_**M**eas	Char.	Only displays changes in the Measurement menus i.e. Measurement Mode, Calibration and Internal Trigger
Update_**A**ll	Char.	Displays all changes and the 'affected' menu. This is the default setting

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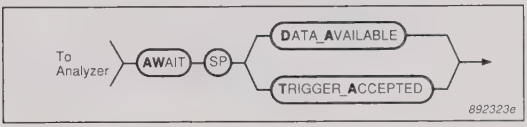
Table 6.4. Update data fields

6.7. AWAIT

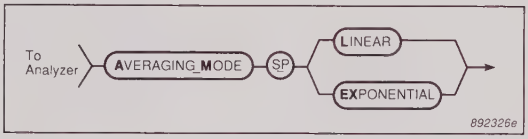
AWait (input only) locks the IEEE interface until a particular event occurs. NRFD (Not Ready For Data) is held back until the specified event occurs (NRFD hold). The events are specified in the syntax diagram below.



Note: AWait cannot be used with the RS–232–C interface.

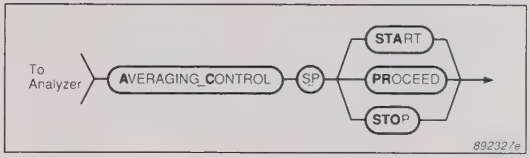
6.8. AVERAGING_MODE

Averaging_**M**ode (input only) is used to choose between linear and exponential averaging.



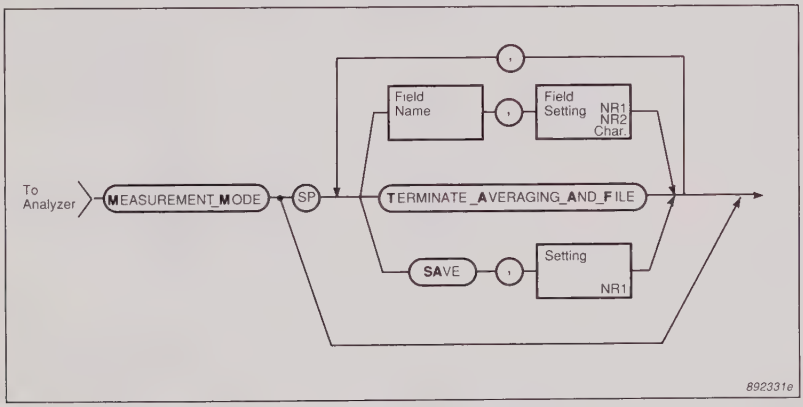
6.9. AVERAGING_CONTROL

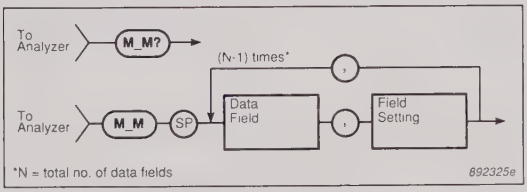
Averaging_**C**ontrol (input only) is used to start, continue and stop an averaging operation.



6.10. MEASUREMENT_MODE

Measurement_**M**ode is used to set one or more specified **M_M** data fields and to display the **M**easurement_**M**ode menu. The input data fields and their settings are listed in Table 6.5. The output message returns a readout of the data fields listed in Table 6.6 below.





Field Name	Field Setting	Data Type	Comments
Centre_**F**requency	<numeric> { **m**[1]Hz / **H**z / **K**Hz	NR (with suffix)	Default is hertz Range of centre frequencies depends on bandwidth
Averaging_**T**ime	<numeric> { **S**econds / **m**[1]illiseconds	NR (with suffix)	Default is seconds. 19 discrete steps from 1/512s to 512s in binary sequence.
Monitor_**S**pectrum_**N**o		NR1	Only in Gated Pass measurement
SAve	1–999	NR1	Not used in Normal
REcall	1.000–999.853	NR1 NR2	NR2 for a multispectrum
Open_**F**ile	1–999	NR1	Only in Normal, real-time
Terminate_ **A**veraging_ **A**nd_**F**ile	[none][2]	–	Only in Normal, real-time
Pass_**N**o		NR1	Only in manual pass measurement
Elapsed_**T**ime[3]		NR2	
Averaging_**S**tatus[3]		Char.	

[1] Lower case m or MI/MS for milli-

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[2] Not a code

[3] Exist as input messages but have no effect

Table 6.5. Measurement_Mode data fields and settings (input)

Field Name	Field Setting	Data Type	Comments
SAve		NR1	This is the figure displayed after 'SAVE IN' on the screen of the analyzer
Elapsed_**T**ime		NR2	
Averaging_**S**tatus	**RE**ady **RU**nning **PA**used **F**inished **W**aiting **SE**ttling	Char.	This field can also be read out using the Averaging_Status message. See section 7.3
Pass_**N**o		NR1	

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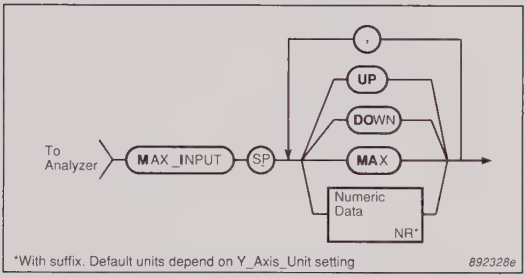
Table 6.6. Measurement_Mode data fields and settings (output)

6.11. MAX_INPUT

Max_Input is used to set the input attenuator, either in single steps or by selecting a specified setting. The output message returns a readout of the current setting.



*With suffix. Default units depend on Y_Axis_Unit setting

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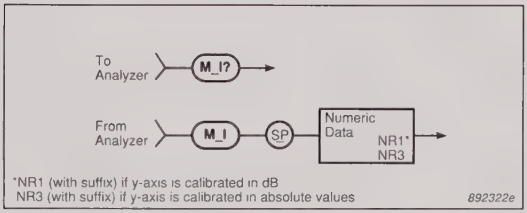

*NR1 (with suffix) if y-axis is calibrated in dB
NR3 (with suffix) if y-axis is calibrated in absolute values

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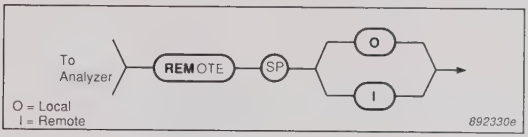
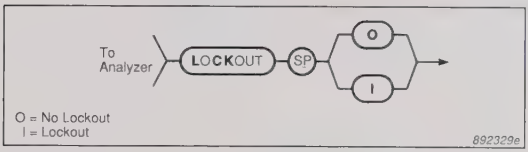
6.12. REMOTE AND LOCKOUT

Note: These messages are only available with the RS–232–C interface.

REMote and **L**o**CK**out are used to control the Remote/Local function of the analyzer via the interface. A brief description of the remote and local states i given opposite.





Interface States:

There are four states. Refer to Fig. 6.1.

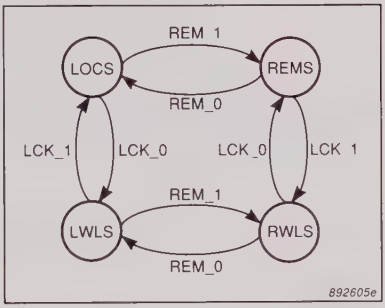


Fig. 6.1. Remote / Local state diagram

1. **LOCS** – Local state: front-panel pushkeys all work normally.
2. **REMS** – Remote state: limited front-panel operation (see section 2.3.3).
3. **RWLS** – Remote with lockout: similar to **REMS**, but the LOCAL pushkey is inoperative.
4. **LWLS** – Local with lockout: front-panel pushkeys all work normally.

Note: When the interface is made ACTIVE, the analyzer is automatically set to the local state (LOCS).

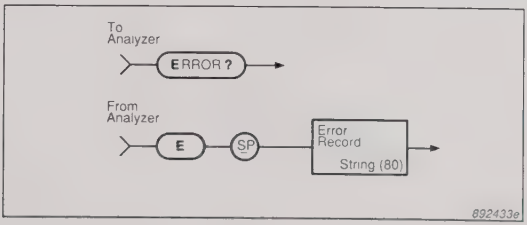
7. STATUS, RESULT AND DISPLAY MESSAGES

7.1. ERROR?

Error? (output only), returns information concerning the most recent error occurring in the analyser. This error record comprises the error number (see Chapter 7 for full list of interface error messages) and a brief description of the error. It is in the form of a character string containing up to 80 characters. The error record is described below, with examples.

After the error record is read out, the record is deleted. If no error has occurred since the last readout of **E?**, the analyzer returns the message:

```
E "NO_ERROR"
```



ERROR RECORD:

<">
Header: 4 char (1-4)
Error_Number: 3 char (5-7)
Error_Trail: 2 char (8-9)
Error_Text: 20 char (10-29)
Message_Header: 7 char (30-36) [1) 2)]
Error_Buffer: 44 char (37-80) [1) 3)]
<">

Example:

```
"ERR 025:  UNKNOWN  CHAR  DATA   F_B    :  BANDW,OCT_3,
UPPER_FREQU,"
```

---

1) Message_Header and Error_Buffer are left out if the error is the result of a manual operation.

Example: "ERR 025: UNKNOWN CHAR DATA"

2) Message_Header is left out if the error occurs on receipt of a header, in which case Error_Buffer is located from 30 to 44.

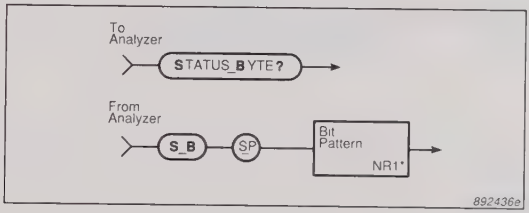
Example: "ERR 123: UNKNOWN INDEX X_X_X"

3) Left out if Error_Stop No is chosen.

Example: "ERR 025: UNKNOWN CHAR DATA F_B :"

7.2. STATUS_BYTE?

Status_**B**yte**?** (output) returns a readout of the 2143 status byte. This is similar to the effect of a serial poll performed via the IEEE interface, except that Busy (bit 5) will always be set. The value read out is the decimal value of the bit pattern.



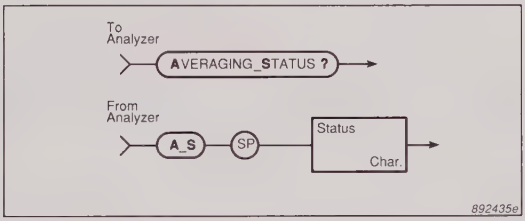
Example:

```
S_B 144.
```

This represents 10010000, i.e. bit 5 (busy) and bit 8 (key pressed) are set.

7.3. AVERAGING_STATUS?

Averaging_**S**tatus**?** (output) returns a readout of the **A_S** data field only, from the Measurement Mode menu.

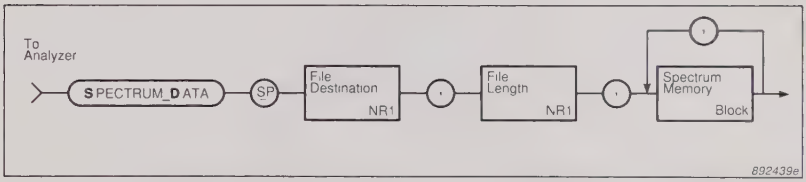


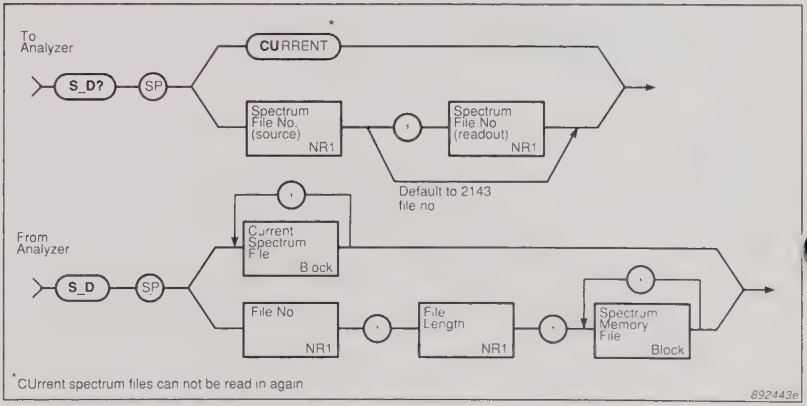
The **A**veraging_**S**tatus field settings are listed below (see also under **M**easurement_**M**ode in section 5.10):

REady
RUnning
PAused
Finished
Waiting
SEttling

7.4. SPECTRUM_DATA

Spectrum_**D**ata is used to load specified spectra into, and to read spectra out of the 2143 spectrum memory. The spectra are input and output in the form of binary block data.





Examples:

Current Spectrum
To obtain a readout of the current spectrum, the controller sends:

S_D? CU

The analyzer responds with:

S_D #3158<data>

Numbered File
To obtain a readout of File 1, the controller sends:

S_D? 1

The analyzer responds with:

S_D 1,339,#3339B&K-2143<data>

Change File Number
To read out File 1 as File 100, the controller sends:

S_D? 1,100

The analyzer responds with:

S_D 100,339,#3339B&K-2143<data>

For further details of the block data format, see section 8.2.

Notes:

- Attempting to read in and save a file using a file number which already exists (or an illegal file number) results in the file not being saved. In addition, the analyzer generates an error message, and the **ABN**ormal bit in the status byte is set. If you do want to use an existing file number then the existing file must first be deleted or renamed.

- If a non-existent file number is specified for output, the **ABN**ormal bit in the status byte is set and the analyzer generates the error message "FILE NOT FOUND".

- If the specified file number is outside the range 1 - 999 the analyzer generates the error message "BAD FILE NAME".

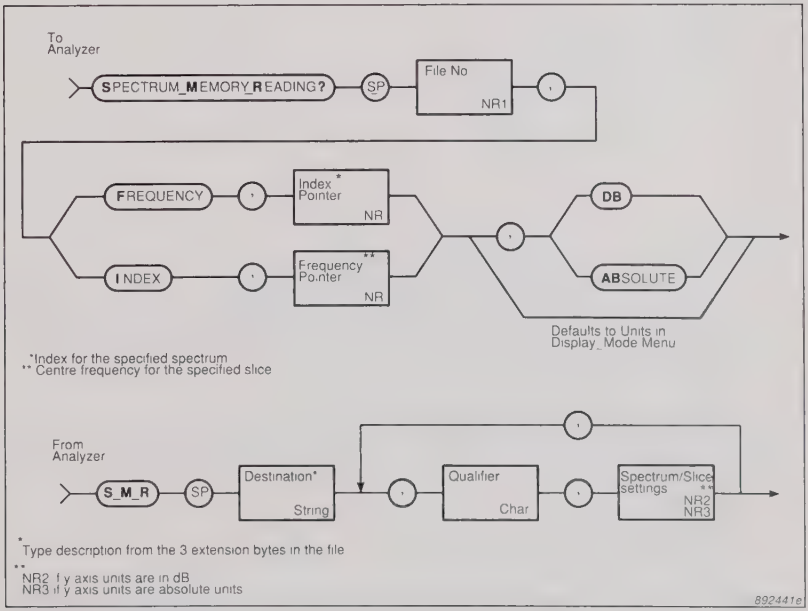
- The Current Spectrum may be read out. However, as it does not have the disk memory format, it cannot be loaded back into the 2143.

7.5. SPECTRUM_MEMORY_READING?

Spectrum_**M**emory_**R**eading? (output) returns a readout of a specified spectrum or slice from spectrum memory. This readout comprises a description followed by a number of Y values (dB or absolute units).

Qualifier can be:

V = Valid
O = Overload
B = Bad



Example:

To obtain a readout from spectrum memory, the controller might send:

S_M_R? 1,F,1,DB

The analyzer responds with (for example):

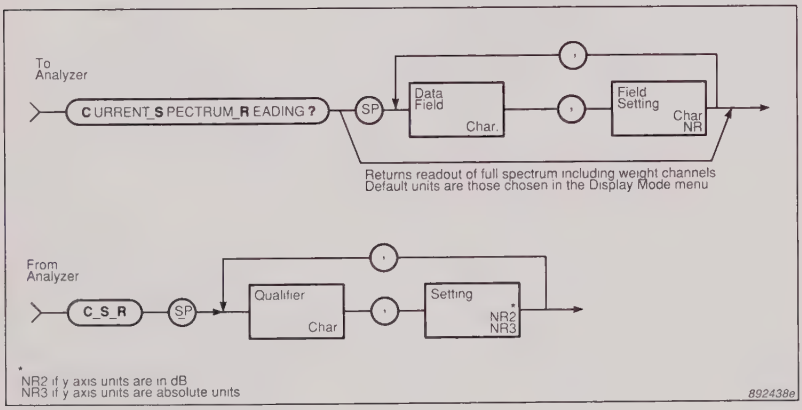
```
S_M_R SINGLE,AUTOSPECTRUM A,1/3 OCTAVE,V,
-385.32,V,46.54,V,-385.3,etc.
```

7.6. CURRENT_SPECTRUM_READING?

Current_**S**pectrum_**R**eading? (output) returns a readout of results from the current displayed spectrum. The start frequency of the readout, and the number of values read out can be specified. The readout may be in dB or absolute units. The data fields and codes are listed in Table 7.1.

Qualifier can be:

V = Valid
O = Overload
B = Bad



Field Name	Field Setting	Data Type	Comments
STArt	<numeric> **A**nalog_**W**eight_**C**hannel **D**igital_**W**eight_**C**hannel	NR Char.	Default is the first frequency band
Number	<numeric> **MA**x	NR Char.	Default is one band
Y_Axis_**U**nit	**DB** **AB**solute	Char.	Defaults to units chosen in Display Mode Menu

T02351GB0

Table 7.1. List of Current Spectrum Reading data fields and codes

Examples:

Full Spectrum
To obtain a readout of the current spectrum in full, the controller sends:

C_S_R?

The analyzer responds with (for example).

C_S_R V,79.75,V,81.91,V,86.41,V,68.23,V etc.

Partial Readout
To obtain a readout of a defined part of the current spectrum, the controller might send:

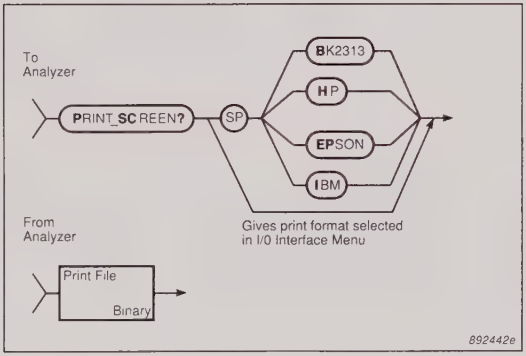
C_S_R? STA,1K,N,3,Y_A_U,DB

The analyzer responds with (for example):

C_S_R V,119.94,V,98.00,V,79.28,

7.7. PRINT_SCREEN?

Print_SCreen (output) reads out a copy of the current analyzer screen to a hard-copy printer. This message has the same function as manual operation of the **"Hard Copy"** push key on the analyzer front panel (see also section 2.3.1).



8. APPENDICES

8.1. ERROR MESSAGES

When incorrect or invalid data is sent to the 2143 an error message is displayed in the bottom right hand corner of the display. A complete list of interface error messages is given in the following sections. For a list of general analyzer errors, refer to the analyzer operating guide.

8.1.1. Interface Status

No listeners
JOB is cancelled
In Remote
In addr mode
In talk mode
In listen mode
Handshake error

8.1.2. Message Content

Overrange
Not an input msg
Not an output msg
Unknown char
Too much data
More data expected
Illegal data type
Illegal data
Not a controller
Autoseq active
Char expected
Integer expected
Numeric expected
String expected

Block-A expected
Illegal input val
Not selectable
Bad file name
File not found
Directory full
Already exists
No memory space
Spectrum mem err
IEEE inactive

8.1.3. Message Structure

Bad termination
Illegal char
Missing char
Input buf overflow
Not allowed
Unknown index
Duplicate index
Illegal NR1
Illegal NR2
Illegal NR3
Exponent overflow
Illegal string
Bad block spec
Illegal block type
Block incomplete
Block overrun
Preface range err
Preface length err

8.1.4. RS–232–C

Parity error
Framing error
Par & fram err
RS-232 overrun
Par err & overrun
Fram err & overrun
Par fram & overrun
CTS off
DSR off
CTS on
RS–232 RX overrun
8 databits needed

8.2. BLOCK DATA FORMAT

This format describes the way block data is sent over the bus by the analyzer. The block data fields conform to the general block data format defined by IEEE Standard 488.2 – 1987.

The length count gives the number of characters in the block length field. The length count is a number in the range 1 to 9. The block length gives the number of data bytes (<DAB>) in ASCII form found after the block length field.

See Fig. 8.1 for the syntax of block data.

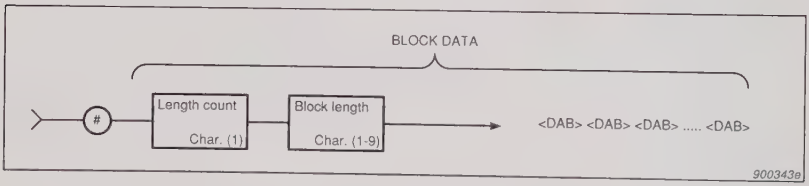


Fig. 8.1. Valid entry of block data

For example,

#3158 <DAB> <DAB> <DAB> . . . <DAB>

158 bytes

8.3. DISK DATA FORMAT AND FILE STRUCTURE

For information concerning internal data representation for the 2143, consult Brüel & Kjær Technical Information Sheet No. 237 "Disk Data Format and File Structure for the Type 2143 Analyzer", available shortly from your local Brüel & Kjær representative.

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